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WELLHEAD PROTECTION MANUAL

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THE COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER SUPPLY

WELLHEAD PROTECTION MANUAL

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WELLHEAD PROTECTION MANUAL

I. INTRODUCTION

The Massachusetts Department of Environmental Protection/Division of Water Supply (DEP/DWS) coordinates and implements the state's Wellhead Protection Program to prevent contamination of public drinking water supply wells.

The Wellhead Protection Program's "pro-active" approach focuses on preventing contaminants from entering the recharge area of a well, and, from there, entering the water supply. Occasionally serious well contamination results from an accidental spill, but more often the cause is a gradual accumulation of contaminants from land uses overlying the recharge area. Because communities in Massachusetts control local land use, they have a singular role in protecting water supplies. DEP recognizes this role and considers local wellhead protection programs fundamental in protecting *all* drinking water supply wells in a community, including municipal wells, small community wells and private wells.

Wellhead protection at the local level is not a new concept. In fact, *most* communities in the Commonwealth have some controls in place, but often there are gaps in protection. A local wellhead protection program is developed through a step-by-step process which ties the various controls together and co-ordinates efforts of municipal departments, businesses and citizens for effective water supply protection. In developing your community's wellhead protection program, you may find that your existing controls need revisions or that they should be augmented by increased educational efforts, inspections or a regulation targeted at a specific threat such as underground storage tanks or hazardous materials. An effective program for wellhead protection should be tailored to the specific needs of your community.

This manual illustrates the minimum DEP/DWS expects, or recommends, for a local wellhead protection program. Westford, Massachusetts was selected as a study community for which to create a model plan for this manual. Accordingly, Westford's wellhead protection program is incorporated as the example in this document. Because communities differ, certain aspects of Westford's program may not apply to your community; nonetheless, DEP's recommended steps for a local wellhead protection program are adaptable to all communities served by groundwater.

DEP/Division of Water Supply Assistance

The DEP/Division of Water Supply has a Technical Assistance Program to answer questions and provide guidance to communities regarding wellhead protection. DEP/DWS also maintains a library of model bylaws, other municipal land use controls, regional planning reports on water supply protection and wellhead protection guides. Please contact:

Community Technical Assistance Program
DEP/Division of Water Supply
One Winter Street
Boston, MA 02108 (617) 292-5770

II. LOCAL WELLHEAD PROTECTION PROGRAM: Summary of Steps

STEP 1 - develop an overview of your community, its water supply system, and the aquifer; establish a water resources protection committee.

STEP 2 - delineate the wellhead protection area for the public water supply well;

STEP 3 - conduct a land use inventory of the wellhead protection area to identify potential sources of contamination and land uses which threaten the well, and
- initiate a regular, on-going schedule of inspections in the wellhead protection area to identify violations of local land use controls, and to educate residents and businesses about best management practices and other ways of protecting the water supply;

STEP 4 - implement land use controls which prohibit high risk future land uses and control the operation and management of existing land uses in the wellhead protection area. This may be accomplished through adoption and enforcement of Board of Health regulations, subdivision regulations and zoning and general bylaws which prevent siting of activities that may threaten groundwater quality;
- provide ongoing education to the public, the business community, municipal officials and water suppliers on the necessity of protecting the water supply and preventing contamination by eliminating and/or controlling threatening land uses and activities within the wellhead protection area; and
- work with adjacent communities to adopt land use controls which protect wellhead protection areas that span political boundaries.

STEP 5 - develop a contingency plan for providing drinking water during water supply emergencies.

The success of a local wellhead protection program depends on the ongoing, co-operative effort of citizens, public officials, the business community, and all who depend on potable water.

Wellhead Protection Terms

Wellhead protection prevents groundwater supply contamination by controlling land uses which occur within the recharge area of a well. DEP divides the recharge area of a well into three zones - Zone I, Zone II and Zone III. Each zone has a different level of significance in terms of wellhead protection, and the boundaries of each zone are determined by a different method.

Zone I, the area requiring the most stringent protection, is a circle with the radius proportional to the well's pumping rate and is determined from the graph entitled *Zone I Protective Radius Graph* (Appendix 1). For example, for public water supply wells with approved yields of 100,000 gallons per day (gpd) or greater, the Zone I radius is 400 feet; for wells with approved yields of 1,000 gpd, the Zone I radius is 250 feet.

Massachusetts Drinking Water Regulations, 310 CMR 22.21(1)4, require public water suppliers to own, or control through a conservation restriction, the entire Zone I. In addition, only those activities directly related to the water supply system are allowed within the Zone I.

Zone II is the delineated land surface which contributes water to a well. It is based on detailed, site-specific hydrogeologic data, and the boundary must be approved by DEP. As part of the Source Approval Process for public supply wells with approved yields 100,000 gpd or greater (310 CMR 22.21(2)), DEP requires municipalities to restrict certain high risk land uses from the Zone II of these new wells. For existing wells, DEP recommends that communities have Zone II's delineated and approved and that communities restrict these high risk land uses from the Zone II.

Zone III is the topographic watershed from which surface water and groundwater drain into the Zone II. The surface water drainage divides, as determined by topography, define the Zone III boundaries. In some cases data may demonstrate that the surface divide is different than the groundwater divide. For these situations, the Zone III boundary is drawn to include areas of surface water drainage and groundwater drainage so that the Zone III always encompasses the entire Zone II.

Interim Wellhead Protection Area (IWPA) is an interim protective area used in the absence of a hydrogeologic study defining the Zone II. For wells with approved yields 100,000 gpd or greater, the IWPA has a radius of one half mile. For wells with approved yields less than 100,000 gpd, the radius of the IWPA is proportional to the pumping rate and is determined from the graph entitled *Public Water Supply Well Pumping Rate vs. Interim Wellhead Protection Area* (Appendix 2). DEP recommends that municipalities restrict the high risk land uses listed in 310 CMR 22.21(2) from IWPA's for all public supply wells.

Wellhead Protection Requirements and Recommendations

Zone I, Zone II

Zone I and Zone II are the most critical parts of a well's recharge area. Water suppliers should make every effort to own, or control through conservation restrictions, the entire Zone I for all public water supply wells, municipal and small community wells alike.

New wells

DEP requires that Zone II's be delineated as part of the Source Approval process for new wells with approved yields of 100,000 gpd or greater. Zone II's must be delineated in accordance with the requirements in the DEP *Guidelines and Policies for Public Water Supply Systems* and submitted to the Department for review and approval. As part of the Source Approval Process, communities are required to adopt wellhead protection controls meeting 310 CMR 22.21(2) for the approved Zone II of the new well. Boundaries of DEP-approved Zone II's are used by DEP and other state agency permitting programs.

Existing wells

Communities are strongly urged to have DEP-approved Zone II's delineated for existing municipal wells and to adopt controls which comply with the Drinking Water Regulation Wellhead Protection Controls, 310 CMR 22.21(2), for the Zone II. DEP approval of a Zone II provides some measure of support against legal challenges to the boundaries.

In cases where an existing public supply well has no approved Zone II, DEP recommends that the community adopt controls covering an Interim Wellhead Protection Area (IWPA) around the well. This recommendation applies for large municipal wells with a one-half mile IWPA radius and for small community wells with the IWPA radius proportional to the pumping rate. (See Appendix 2: *Public Water Supply Well Pumping Rate vs. Interim Wellhead Protection Area* Graph)

Wells permitted under the Water Management Act

Zone II's and local wellhead protection controls meeting 310 CMR 22.21(2) are required for public water supply wells permitted under the Water Management Act.

Conceptual Zone II's

In cases where a public supply well was installed before the adoption of the DEP regulations requiring Zone II delineations and certain hydrogeological information is not available, DEP encourages communities and their consultants to consider delineating a Conceptual Zone II in accordance with criteria set forth in DEP's *Guidelines and Policies for Public Water Supply Systems*. A Conceptual Zone II for an existing well is based on more general hydrogeologic information and is less costly to delineate than is a Zone II. The proposed Conceptual Zone II must be submitted to DEP for review and approval. Once approved, the Conceptual Zone II is afforded the same regulatory status as any DEP-approved Zone II.

Private wells, future well sites

Communities are encouraged to adopt land use controls to protect private wells and future well sites outside approved Zone II's or IWPA's. These controls may include private well construction guidelines, general bylaws regulating hazardous materials and underground storage tanks, program to reduce use of road salt, or regulations concerning septic tank maintenance, depending on the specific activities which threaten those wells.

Zone II's/IWPA and state permitting programs

Approved Zone II's for all wells, new and existing, and IWPA's for public supply wells with approved yields 100,000 gpd or greater, are incorporated into DEP and other state permitting decisions. For example, the DEP/Division of Solid Waste does not permit new landfills within the boundaries of an approved Zone II or an IWPA, and existing facilities (with some exceptions) must close before July 1, 1995. The Bureau of Waste Site Cleanup may classify a disposal site as a priority for cleanup if there is evidence of groundwater contamination within an approved Zone II or an IWPA. The Massachusetts Department of Food and Agriculture has recently promulgated regulations restricting pesticide use within approved Zone II's and IWPA's for large wells. IWPA's for small community wells (with yields less than 100,000 gpd) are not uniformly incorporated into state permitting programs.

Overlay districts which do not follow DEP-approved Zone II or IWPA boundaries

In communities where the overlay district does not follow the boundaries of DEP-approved Zone II's or IWPA's, often the boundaries are based on USGS maps of high and medium yield aquifers or similar sources of information. Such an overlay district does not delineate recharge areas for specific wells. Because DEP does not review or approve the boundaries of these districts, they are not afforded regulatory status by state programs. For this reason, DEP strongly urges communities to have DEP-approved Zone II's delineated for their public supply wells and to use these boundaries as a basis for the boundaries of the overlay districts.

Selection of appropriate controls

For maximum effectiveness, the wellhead protection controls which communities apply should be tailored to the specific situation, including type of threat and location of the threat in relation to the wells.

III. STEPS OF A LOCAL WELLHEAD PROTECTION PROGRAM

STEP 1 - Develop an overview of your community, its water supply system and the aquifer; establish a water resources protection committee.

The initial step in the development of a wellhead protection program is to gain familiarity with characteristics of the community and of the aquifer which supplies the wells.

What your community should do

DEP recommends that each community establish a water resources protection committee to develop and periodically review the local wellhead protection program and to deal with other issues related to protection of the water supply. All relevant departments, boards, commissions and local interests should be represented, including representatives of the office of chief elected official, Conservation Commission, Planning/Zoning Board, Board of Health, Board of Water Commissioners, Fire Department, Police Department and Chamber of Commerce.

Ideally, the members of the committee should have some knowledge of the community's present and estimated future growth patterns, land use patterns, water distribution system, aquifer characteristics and understand basic concepts of groundwater flow to a well as a foundation for understanding how land use controls can protect a water supply from contamination.

STEP 2 - Delineate the wellhead protection area

Delineation of accurate recharge areas for each public supply well is critical to protecting the water supply from contamination. Land use controls based on inaccurate recharge area boundaries may not protect a large enough area, leaving the well vulnerable to contamination. Boundaries which cover too large an area may result in a community implementing and enforcing land use controls in areas that do not provide recharge to the well. With accurately mapped boundaries, a community can apply controls where they will be most effective for wellhead protection and the most defensible against legal challenges.

What your community should do

A community should have its consultant delineate the Zone II of an existing well in accordance with criteria in the *Guidelines and Policies for Public Water Supply Systems*, and

submit the proposed delineation to DEP for review and approval. Zone II's delineated in accordance with these *Guidelines* are required for DEP approval of new public supply wells with approved yields over 100,000 gpd.

Because Zone II's are based on site-specific hydrogeologic data, DEP considers the Zone II to be the most accurate delineation of a well's recharge area. DEP-approved boundaries are incorporated into DEP and other state regulatory programs. DEP approval of a Zone II also provides support against legal challenges to the boundaries.

If a community presently is unable to accommodate the cost of delineation of a Zone II for an existing well, DEP recommends that the community budget for this in the future, but, at a minimum, apply land use controls cited in 310 CMR 22.21(2) to an IWPA now. The correct radius of an IWPA for all public supply wells is determined from the graph entitled *Public Water Supply Well Pumping Rate vs. Interim Wellhead Protection Area* (Appendix 2).

Once the wellhead protection areas are delineated and mapped on a town base map with parcel boundaries, the process of identifying threatening land uses and activities begins (STEP 3).

STEP 3 - Inventory land uses and initiate schedule of inspections within the wellhead protection area

Before appropriate controls can be implemented, the community must know which activities or land uses, potential or existing, pose a threat to the water supply. One of the difficulties in developing a complete inventory is that the information must be obtained from many different sources, including inspections of the properties within the wellhead protection area and from records from various divisions of DEP such as Solid Waste, Water Pollution Control and Bureau of Waste Site Cleanup.

The inventory process should also include your local Board of Health and Fire Department which may be able to provide information on hazardous material used or stored on sites, location, content, and age of underground storage tanks, major discharges or hazardous material spills. Your inventory of land uses should cover the entire area of the Zone II or IWPA, even if it extends into an adjacent community.

To help identify potentially threatening land uses, communities should refer to the *Guide to Contamination Sources for Wellhead Protection.* Copies were distributed statewide, in 1989, to boards of health, planning board members and other persons with a role in wellhead protection. If this document is not available in your community, it may be obtained, for a fee, from the State House Bookstores, Boston, 02108 (617)727-2834 or 21 Elm Street, Springfield, MA 01103 (671)784-1376.

What your community should do

Your community should conduct inspections of each property within the wellhead protection area outlined in STEP 2. From the inspection, an assessment can be made of the activity on each property and the threat, in terms of water supply protection, of each activity. Equally important, each inspection presents an opportunity to educate residents and businesses about the significance of the wellhead protection area, the importance of reducing the use of hazardous materials and of using and disposing of hazardous materials properly to protect the water supply.

The Land Use/Public Supply Well Pollution Potential Matrix (Fig. 1) in the *Guide to Contamination Sources for Wellhead Protection* is a compilation of information on land uses and potential contaminants. It can also be used as a checklist for the inventory of land uses.

Water suppliers must regularly inspect the area within the protective radius (Zone I) around the well to be sure activities such as vandalism or illegal dumping are not occurring and to be sure their own activities, such as storage of cleaning products or fuel, do not pose a threat to the water supply.

Once the initial inventory of the entire wellhead protection area has been completed, a system for periodic inspection should be instituted. The water supplier is required by the DEP/Division of Water Supply/Water Quality Assurance Section to inspect, once a year, land uses in the Zone II/IWPA's and report the results of the inspection on the *Annual Water Supply Statistics, Form C.*

STEP 4 - Implement Protective Land Use Controls

Once the inventory of threats is completed, the community must address the best method of controlling those threats. It is the implementation of land use controls, and subsequent follow-up inspection and enforcement, and public education that ultimately protects the water supply.

What your community should do

DEP recommends that protective land use controls in wellhead protection areas prohibit high risk uses, restrict medium risk uses and control existing uses.

The following is a sequence of steps a community should take when evaluating its protective land use controls:

- Compare and evaluate effectiveness of existing controls, including applicability of the control and adequacy of enforcement provisions, against existing and potential land use threats.

FIGURE 1

LAND USE/PUBLIC-SUPPLY WELL POLLUTION POTENTIAL MATRIX

Land Use Considerations / Potential Contaminants	Acids	Bases	Chloride	Fluoride	Iron/Manganese (Fe/Mn)	Metals (except Fe & Mn)	Nitrate[1]	Pathogens (Virus/Bacteria)	Pesticides/Herbicides	Petroleum Products	Phenols	Radioactivity	Sodium	Solvents	Sulfate	Surfactants (Detergents)
Overall Threat to Public Health	L-M	L-M	L	L	L	H	M	L	H	H	H	H	L	H	L	L
Mobility	M	L	H	H	M	L-H	H	L	L-H	M	M	L-H	H	H	H	H
Natural Background	■		■	■	■	■						■	■		■	

Land Use Categories	Acids	Bases	Chloride	Fluoride	Iron/Manganese (Fe/Mn)	Metals (except Fe & Mn)	Nitrate[1]	Pathogens (Virus/Bacteria)	Pesticides/Herbicides	Petroleum Products	Phenols	Radioactivity	Sodium	Solvents	Sulfate	Surfactants (Detergents)	Overall Threat to Public Water Supply[3]
Agriculture/Golf Courses							■		■								M
Airports						■			■	■				■		■	M-H
Asphalt Plants										■							L-M
Beauty Parlors		■				■								■		■	L[2]
Boat Yards/Builders						■				■	■			■			L
Car Washes			■			■				■			■	■		■	L
Cemeteries									■								L
Chemical Manufacture	■	■	■	■	■	■	■		■	■	■	■	■	■	■	■	H
Clandestine Dumping	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		H
Dry Cleaning														■			H
Furniture Stripping and Painting	■	■				■								■			M
Hazardous Materials Storage and Transfer	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	H
Industrial Lagoons and Pits	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	H
Jewelry and Metal Plating	■	■		■	■	■				■			■	■		■	M
Junkyards	■				■	■				■				■	■		L
Landfills	■		■		■	■	■	■	■	■	■	■	■	■	■		H
Laundromats								■						■		■	L-M
Machine Shops/Metal Working	■	■				■				■				■		■	H
Municipal Wastewater/Sewer Lines					■	■	■	■					■	■		■	H
Photography Labs/Printers	■	■				■								■		■	L M
Railroad Tracks and Yards Maintenance Stations	■	■	■	■	■	■	■		■	■	■	■	■	■	■	■	M
Research Labs/Universities/Hospitals	■	■		■	■	■	■	■	■	■	■	■		■		■	L-M
Road and Maintenance Depots			■						■	■			■	■			M
Sand and Gravel Mining/Washing										■				■			L
Septage Lagoons and Sludge			■		■	■	■	■					■	■		■	H
Septic Systems, Cesspools and Water Softeners			■		■	■	■	■	■				■	■		■	H
Stables, Feedlots, Kennels, Piggeries, Manure Pits							■	■					■				M H
Stormwater Drains/Retention Basins			■			■		■	■	■			■	■			L M
Stump Dumps					■	■	■				■		■				L
Underground Storage Tanks									■	■				■			H
Vehicular Services						■				■				■		■	H
Wood Preserving						■				■	■			■	■	■	L

■ The contaminant(s) released from this land-use category *may render* groundwater at a public-supply well undrinkable in accordance with federal and state maximum contaminant levels.

□ This land use category is not generally associated with the release of the particular contaminant in quantities that would render the groundwater at a public-supply well undrinkable. However, the contaminant may be associated with a particular activity.

L = Low Threat M = Medium Threat H = High Threat

This Matrix is based on a literature review and the combined field experience of the Cape Cod Aquifer Management Project (CCAMP). **THIS MATRIX SHOULD BE USED AS A GUIDE AND HANDY REFERENCE.** It is not a substitute for looking at a particular land use in detail. There will always be the potential for a business to use an unusual process using chemicals not normally associated with that business. The land-use categories included in the Matrix and *Guide to Contamination Sources for Wellhead Protection* are those that might be found in the primary recharge area of a public-supply well in Massachusetts. This Matrix may be misleading or erroneous if applied to low-yield private wells.

1 Nitrate has a cumulative impact on groundwater quality. No one category is responsible for the release of nitrate. A variety of land use categories release nitrate. These include animal feedlots, landfills, septic systems, septage lagoons, municipal wastewater and agricultural activities including turf maintenance.

2 There are no known instances of beauty parlors contaminating well water in Massachusetts. More research is needed to determine the severity of a threat to groundwater from this land use category.

3 Refer to *Guide to Contamination Sources for Wellhead Protection* pp. 1-2.

- Examine the results of the land use inventory and identify specific land uses or activities, existing and potential, which are not adequately controlled by existing regulations.

- Adopt controls covering the approved Zone II's or IWPA's for existing wells which, at a minimum, meet the state regulations on wellhead protection, 310 CMR 22.21(2).

- Educate public officials on the importance of wellhead protection controls and implement and enforce the controls. Be sure all local boards, building inspector, plumbing inspector, and others, are aware of and understand the wellhead protection measures. Coordination among local officials, such as the board of health, the zoning enforcement officer, the fire chief and the water supplier, is key to consolidation of effort and improvement in the effectiveness of wellhead protection enforcement actions.

- Promote public education programs which address relevant threats to your community's water supply. For example, in communities where unsewered residential development occurs within the wellhead protection area, residents should be instructed on the proper maintenance of a septic system and on the proper use and disposal of household hazardous wastes. Educational programs should also include presentations to all levels of schools. Community awareness of the importance of wellhead protection is needed for adoption of and compliance with the necessary controls.

- If the Zone I of the public supply well is not owned or controlled by the municipality, or if there are inappropriate land uses within the Zone I, the municipality should pursue purchase of land or conservation restrictions within the Zone I and eliminate the inappropriate uses.

DEP recommends that a community adopt controls that meet the standards specified in 310 CMR 22.21(2) for the approved Zone II or IWPA for each existing well.

DEP requires communities with wells going through the Source Approval Process and communities with wells that must be permitted under the Water Management Act to adopt controls which, at a minimum, comply with 310 CMR 22.21(2). Many communities incorporate these controls into their zoning bylaws; however a community may adopt these controls through general bylaws, board of health regulations, or other approaches. Communities are encouraged to adopt stricter controls as the situation warrants.

When the wellhead protection area for one community's well extends into adjacent communities, DEP recommends those communities work together to protect the water supply. To meet DEP requirements for approval of new sources, the community which owns the well must demonstrate it has made a "best effort" to convince the communities into which the Zone II or IWPA extends to adopt equivalent zoning and non-zoning controls for those portions of the wellhead protection area.

If a Zone II, or IWPA, of a municipal well or small community well in an adjacent community extends into your community, your community should protect that well by adopting controls which meet DEP's wellhead protection requirements to cover the wellhead protection area.

Table 1 summarizes the land use controls recommended or required by DEP for new wells, existing wells, private wells, future well sites and other areas.

Table 1: Summary of Minimum Land Use Controls for Wellhead Protection

A. Controls that meet DEP Wellhead Protection Requirements (310 CMR 22.21(2):

should be applied by communities to:
- Zone II's or IWPA's of your community's existing wells
- Zone II's or IWPA's of existing municipal wells of adjacent communities that extend into your community
- IWPA's of small community wells in your community
- IWPA's of small community wells in adjacent communities that extend into your community

must be applied by communities to:
- new wells with required Zone II's for Source Approval
- wells permitted under the Water Management Act

B. Protective controls should be applied by communities to:
- private wells
- future well sites
- medium and high yield aquifer areas
- Zone III

C. Communities must prohibit, within required Zone II's, (310 CMR 22.21(2))*:
- land fills and open dumps
- automobile graveyards and junkyards
- stockpiling or disposal of snow or ice containing de-icing chemicals
- individual sewage disposal systems handling more than 110 gallons per day per quarter acre
- waste water treatment plants; and
- facilities that generate, treat, store or dispose of hazardous waste

D. Communities must prohibit, within required Zone II's, unless specified performance standards are met (310 CMR 22.21(2))*:
- uses involving storage of sludge and septage; de-icing chemicals; commercial fertilizers, soil conditioners, and manure; liquid hazardous materials; and liquid petroleum products;
- uses involving earth removal activities;
- impervious surfaces greater than 15% or 2,500 square feet of any lot

E. Additional measures that should be considered by communities include:
- underground storage tank controls
- registration and inspection of businesses using toxic and hazardous materials
- programs to reduce road salt
- spill response programs
- septic tank maintenance programs
- household hazardous waste education and collection programs

*DEP recommends that communities adopt these restrictions within approved Zone II's of existing wells and within IWPA's for all public supply wells.

STEP 5 - Water supply contingency plan

A local water supply contingency plan is a plan for providing drinking water to a community when the supply of water does not meet the demand. It plans for the efficient allocation of water when supply is limited by identifying and evaluating alternative sources of water, methods of allocation to consumers for various purposes and for different periods of time.

A water supply contingency plan differs from an emergency response plan which focuses on aspects of water supply emergencies such as notification of the public and the proper authorities, water quality testing schedule and repair of the water supply system.

A local water supply contingency plan should include, at least:

- assessment of demand, including average day and peak day demand, seasonal variation by category of users and including future projections for supply and demand

- ranking of categories of water users, and of uses within each category (fire protection, hospitals, schools, residences, industry, recreation)

- inventory of existing water supply and distribution system, including storage capacity

- inventory of short term vs. long term alternative sources (backup supplies, inter connections, bottled water, water conservation, improvements to water supply and distribution system) including water quantity and quality limitations

- evaluation of mutual aid agreements with other towns including quantity of water to be supplied, length of time or other limiting conditions

- schedule for testing interconnections and other potential supplies

- potential causes of disruption (drought, power loss, pipe break, contamination), estimated time for provision of emergency supply, portion of the system/users that would be affected

- assessment of previous water supply emergency responses including quantity and quality of water supplied, cost, startup delays or interruptions in service, length of time supplied

- list of emergency response officials to contact

Public water suppliers must complete, and submit to DEP, Form G, "Emergency Plan Vulnerability Assessment Questionnaire" which is part of the annual *Community Public Water Supply Statistics Report.*

IV. WELLHEAD PROTECTION PROGRAM FOR WESTFORD, MASSACHUSETTS

STEP 1 - An overview of Westford, the water supply system and the aquifer

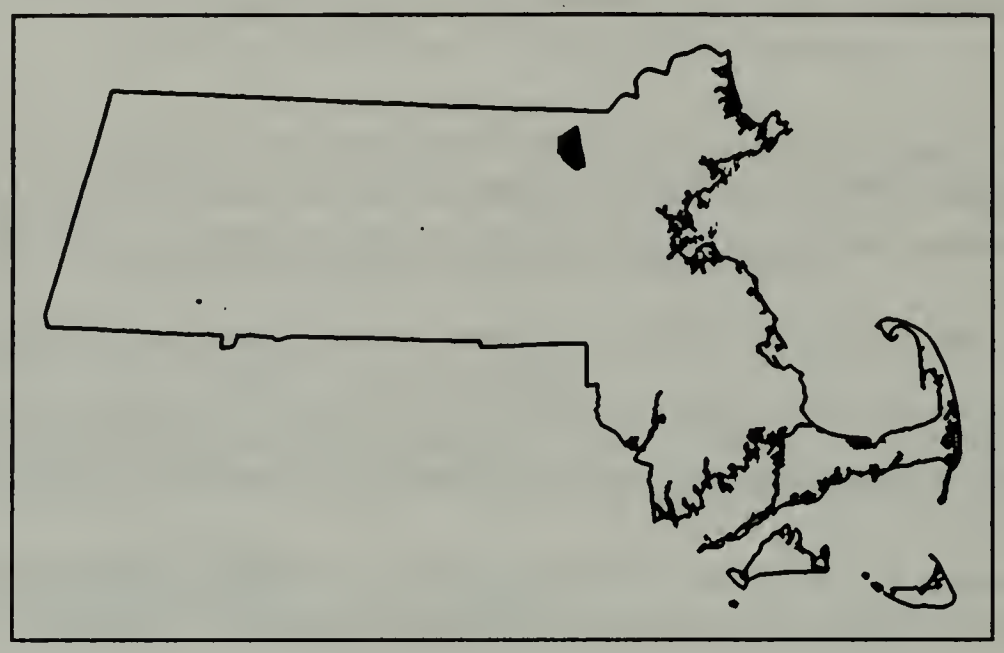


Fig. 2 Location: Westford, Massachusetts

Westford is semi-rural; most development is residential. Industrial development is sparse, and major commercial activity is concentrated near I-495.

Westford has no municipal sewerage system. All residential septic waste is handled by individual septic systems. Commercial/industrial sanitary waste is handled similarly, with several establishments regulated by groundwater discharge permits for discharge of sanitary waste in excess of 15,000 gal/day.

Approximately two-thirds of Westford's 16,600 residents are served by the municipal water supply, accounting for 85% of the demand. The remaining one-third is outside the municipal distribution system and is served by private and small community wells. About 13% of the municipal water goes to commercial/industrial uses - most commercial/industrial facilities rely on their own wells. Municipal, agricultural and miscellaneous purposes account for about 2% of the demand.

Westford's public water supply is drawn from seven wells in the Stony Brook aquifer. Average day demand is 1.3 million gallons per day (mgd). Peak day demand is 2.6 mgd.

Table 2 provides a summary of Westford's municipal water supply wells.

Table 2: Westford Municipal Water Supply Wells

Public Water Supply Identification Number: 2330000
Aquifer Type: Unconfined, glacial-filled, stream-valley aquifer
Material: Sand and gravel
Sanitary Well Seals: concrete seals on all wells
Population Served: 12,000
Zone I for each well: town owned

Well Name	PWS ID #	DEP-Approved Yield (gpm)	DEP-Approved Yield Mgal/day	Actual Amount Pumped (1990) Mgal/day	Well Depth (feet)	Depth To Bedrock	Year Brought On-line
Forge Village wellfield	01G	(200)	.299 Mgal/day	.065 Mgal/day	35'	35'	1907
Nutting Road well	02G	(450)	.648 Mgal/day	.363 Mgal/day	45'	53'	1962
Depot Road well	03G	(500)	.720 Mgal/day	.369 Mgal/day	50'	50'	1967
Country Road well	04G	(500)	.720 Mgal/day	.134 Mgal/day	64'	64'	1966
Forge Village well	05G	(500)	.720 Mgal/day	.171 Mgal/day	62'	63'	1970
Howard Road wellfield	06G	(500)	.720 Mgal/day	.231 Mgal/day	35'	40'	1987
Cote well	07G	(450)	.648 Mgal/day	.101 Mgal/day	40'	50	1989
Totals			4.464 Mgal/day	1.333 Mgal/day			

The Stony Brook aquifer is a glacial-filled, stream-valley aquifer, which is a common type of aquifer in New England. Because this aquifer material was deposited by flowing glacial meltwater, it tends to be stratified into layers of similar-sized soil particles, but the layers are irregular in area and thickness. The layers of coarse-grained material readily transmit water while layers of fine-grained material do not. The Stony Brook aquifer yields large quantities of water because of the predominance of layers of coarse-grained material. It is a highly permeable, unconfined aquifer.

In Westford, the Stony Brook aquifer's saturated thickness averages 40 to 50 feet, and the water table is at, or within a few feet of, the ground surface. Because the municipal wells are relatively shallow (average 47 feet deep), they are especially vulnerable to contamination from surface spills and road salting. Because of the ease with which water, and other fluids, move through the coarse grained layers, the Stony Brook aquifer is also vulnerable to contamination from sources such as leaking underground storage tanks (UST's).

STEP 2 - Westford's municipal wellhead protection areas

DEP has approved Zone II's for three of Westford's seven on-line wells. Presently two proposed well sites (Sites 7 and 11), in the vicinity of the four wells with IWPA's, are in the

Source Approval process. The required Zone II for Sites 7 and 11 will encompass the four wells with IWPA's. Once the Zone II is approved for Sites 7 and 11, Westford will have approved Zone II's for all municipal wells.

Table 3 summarizes the status of the wellhead protection areas for each of Westford's municipal wells and proposed well sites.

Table 3: Westford's Municipal Wellhead Protection Areas

Well	Wellhead Protection Areas	Date of DEP-Approval
Nutting Road Well	DEP-approved Zone II	1992
Depot Road Well	DEP-approved Zone II	1992
Cote Well	DEP-approved Zone II	1989
Forge Village #1	Interim Wellhead Protection Area (1/2 mile radius)	pending
Forge Village #2	Interim Wellhead Protection Area (1/2 mile radius)	pending
Country Road well	Interim Wellhead Protection Area (1/2 mile radius)	pending
Howard Road	Interim Wellhead Protection Area (1/2 mile radius)	pending
Sites 7 and 11 (proposed)	proposed Zone II	pending

Figure 3, following, shows the location of the Westford municipal wells and the boundaries of the wellhead protection areas.

STEP 3 - Westford's Land Use Inventory

Westford owns the Zone I of each municipal well, and the water department inspects, at least annually, each Zone II and IWPA.

The primary threats to Westford's public water supply come from residential septic systems, household hazardous waste that may be poured down the drain and from underground storage tanks. Westford should focus on controls for these threats, such as a strong public education effort on the importance of proper maintenance of septic systems and proper disposal of household hazardous wastes, combined with prohibition of the use of septic tank cleaners. Additionally, Westford should adopt a spill response plan to address the potential problem of a hazardous material release if an accident occurs involving a train transporting hazardous material.

Table 4 lists the land use threats located within Westford's municipal wellhead protection areas.

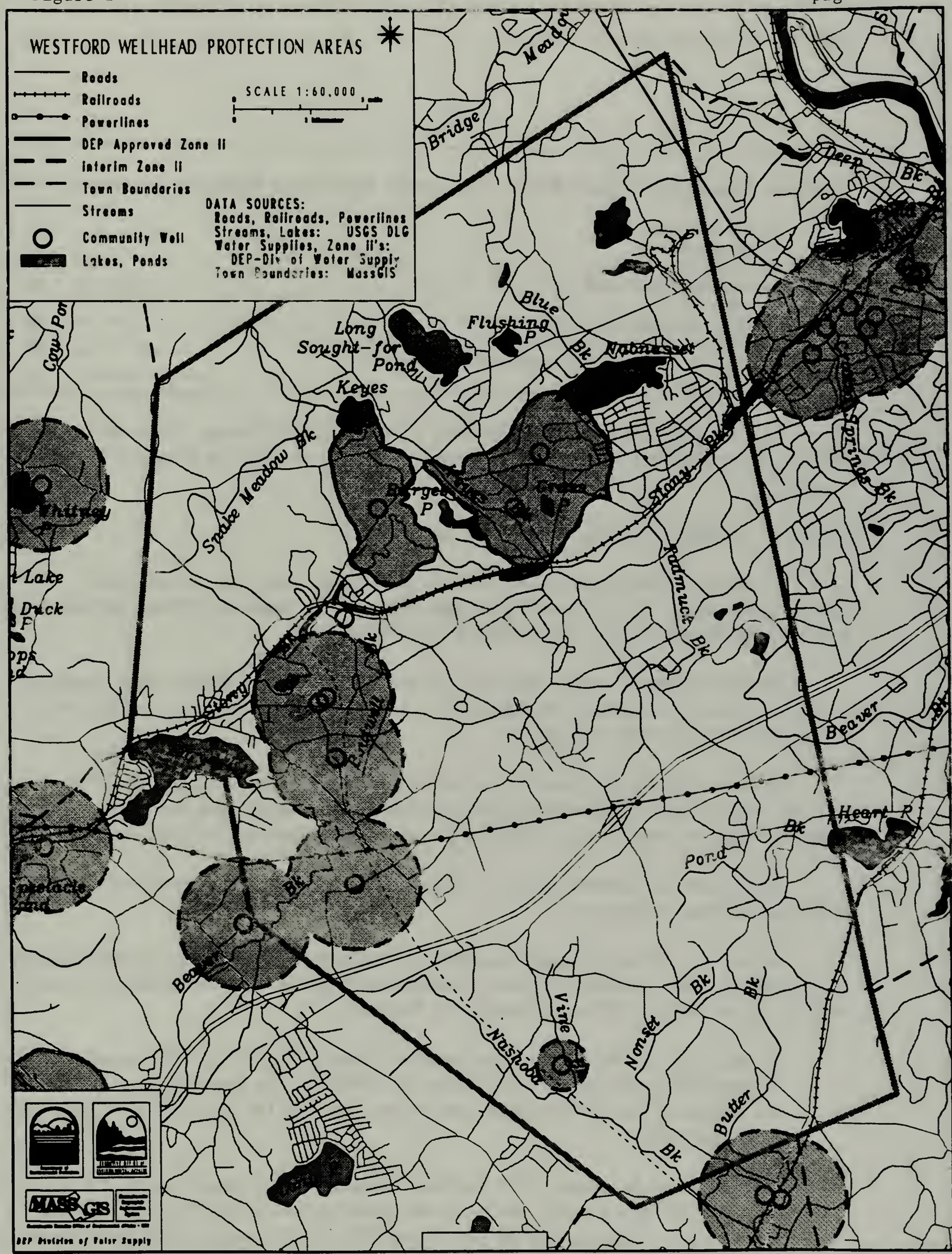

WESTFORD WELLHEAD PROTECTION AREAS
Roads
Railroads
Powerlines
DEP Approved Zone II
Interim Zone II
Town Boundaries
Streams
Community Well
Lakes, Ponds
SCALE 1:60,000
DATA SOURCES:
Roads, Railroads, Powerlines
Streams, Lakes: USGS DLG
Water Supplies, Zone II's:
DEP-Div of Water Supply
Town Boundaries: MassGIS
Bridge
Meadow
Deep Bk
Blue
Flushing P
Long
Sought-for Pond
Keyes
Cow Pond
Spike Meadow Bk
Stony Bk
Trines Bk
Lake
Duck P
Beaver
Heart P
Pond
Bk
Vine
Nashoba
Nonset
Butter
MASS GIS
DEP Division of Water Supply

Table 4: Land Use Threats Within Westford's Municipal Wellhead Protection Areas

dry well (UIC well)
salt storage shed
septic systems
household hazardous waste
road salt
underground storage tanks (UST)
herbicide/pesticide use along roads and railroad right of way
confirmed hazardous waste site - leaking UST (removed)

Figure 4, following, shows the location of *some* of these threats. (The small size of the map printed in this manual makes it impossible to show all these threats.)

STEP 4 - Westford's Protective Land Use Controls

Westford has implemented several land use control measures to protect its groundwater supply from contamination, including a Water Resources Protection Zone bylaw, a Hazardous Materials bylaw and an Earth Removal bylaw.

Water Resource Protection Zone (zoning bylaw) - an overlay district which regulates certain land use activities such as junkyards, automotive repair stations, etc. which might threaten Westford's water supply.

Aquifer Protection (general bylaw, also known as the "Hazardous Materials" bylaw) - requires registration of defined hazardous or controlled materials with the Board of Health, proper storage, as specified, and regulates the underground storage of liquid materials.

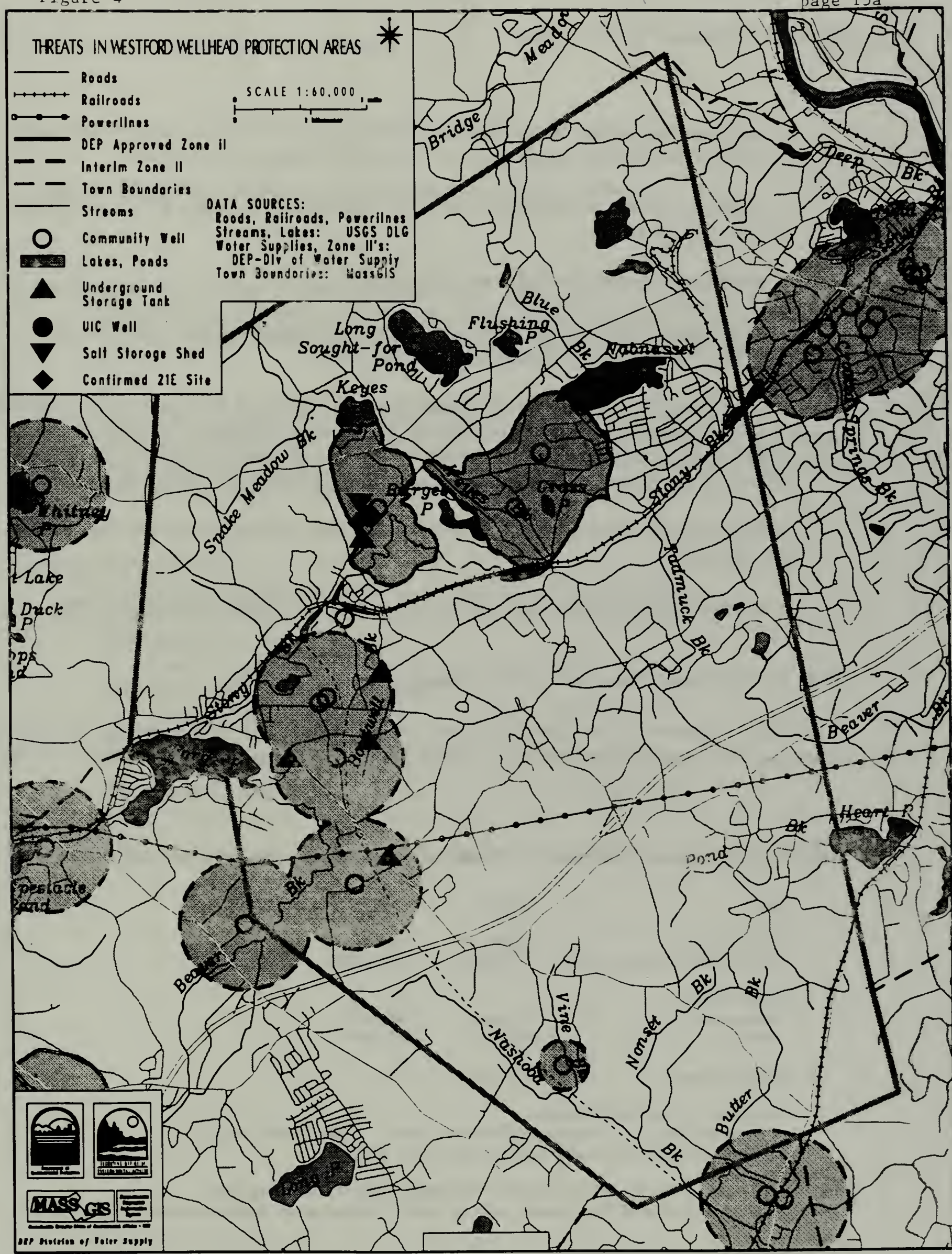
Earth Removal (general bylaw) - prohibits removal of sand and gravel within six feet of the spring high water table.

At the time of this writing, Westford is in the process of amending its zoning bylaw and reviewing other wellhead protection measures to increase the protection to the water supply. In particular, DEP recommends that Westford:

- include in its Water Resource Protection Overlay District all DEP-approved Zone II's and IWPA's for its municipal wells, the IWPA for the small community well and the portion of the IWPA's which extend into Westford for the Acton and Littleton municipal wells.

- adopt controls meeting DEP wellhead protection requirements (310 CMR 22.21 (2)) covering the Zone II's and IWPA's for its municipal wells, the IWPA for the small community well and for the portion of the IWPA's which extend into Westford for the Acton and Littleton municipal wells.

Figure 4


THREATS IN WESTFORD WELLHEAD PROTECTION AREAS
Roads
Railroads
Powerlines
DEP Approved Zone II
Interim Zone II
Town Boundaries
Streams
Community Well
Lakes, Ponds
Underground Storage Tank
UIC Well
Salt Storage Shed
Confirmed 21E Site
SCALE 1:60,000
DATA SOURCES:
Roads, Railroads, Powerlines
Streams, Lakes: USGS DLG
Water Supplies, Zone II's:
DEP-Div of Water Supply
Town Boundaries: MassGIS
Meadow
Bridge
Deep Bk
Blue
Flushing P
Bk
Nabnasset
Long
Sought-for Pond
Keyes
Snake Meadow Bk
Stony Bk
Spring Bk
Whitney
Lake
Duck P
Stony
Bk
Padmuck Bk
Beaver
Bk
Heart P
Pond
Bk
Beaver
Bk
Bk
Vine
Nashoba
Nonset
Bk
Butter
Bk
MASS GIS
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- maintain its existing Water Resources Protection District to protect private wells and future well sites or adopt controls for specific threats to those wells.

- adopt a program, in conjunction with the Department of Public Works, to reduce the use of road salt.

- consider protective fencing around pump houses.

- continue public education efforts on proper maintenance of septic systems and handling and disposing of household hazardous waste.

- controls applied specifically to the approved Zone II's and IWPA's should be adopted to limit discharge of septic systems within these areas to comply with 310 CMR 22.21(a)5 which prohibits individual sewage disposal systems handling more than 110 gallons of sewage per quarter acre per day or 440 gallons per acre per day.

- adopt a spill response plan for handling accidents involving materials transported on the railroad.

- address the use of herbicides along the railroad and utility line rights of way.

STEP 5 - Outline of Westford's Water Supply Contingency Plan

DEP recommends that Westford expand on the basic information presented in Table 5 to meet at least the minimum scope of a Water Supply Contingency Plan (see Step 5, p. 11).

Table 5: Information Relevant to Westford's Water Supply Contingency Plan

Year	1990*	2000*
Total Population	16,600	18,450
% (#) of pop. on private wells	30% (5,000)	15% (2,800)
Water Demand		
average day	1.3 mgd	2.6 mgd
peak day	1.8 mgd	3.6 mgd
Storage capacity	3.7 mgal.	-----

Breakdown by User (% of Demand):
Residential (85%) Commercial/Industrial (13%) Municipal/Other (2%)
(Most commercial/industrial enterprises use private wells.)

(*1991 data from *Annual Statistics Report* filed with DEP/DWS/Quality Assurance Section.
Year 2000 data from Division of Water Resources/Dept. of Envir. Management, Boston, personal communication.)

Step 5: Westford's Water Supply Contingency Plan (cont.)

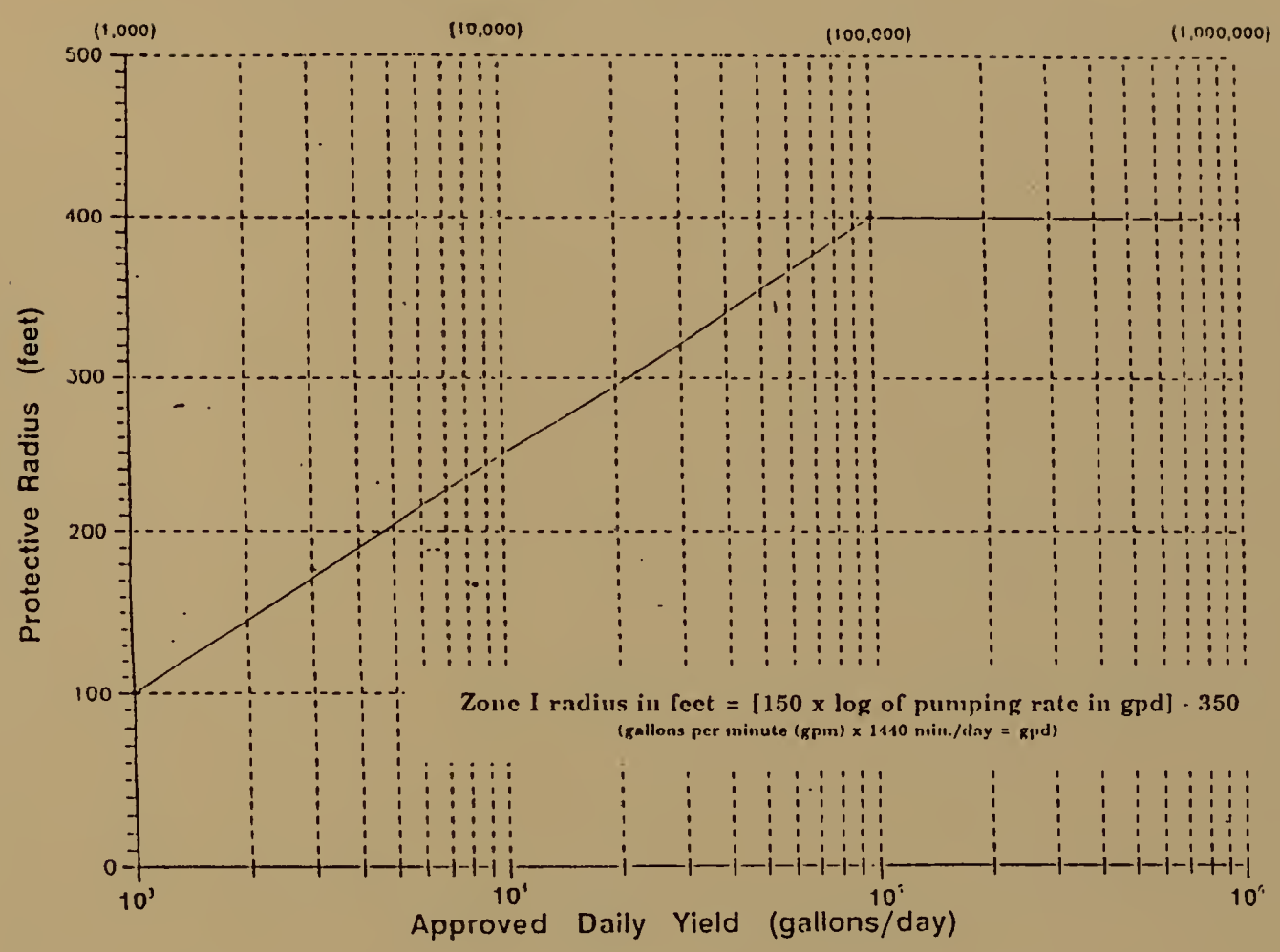
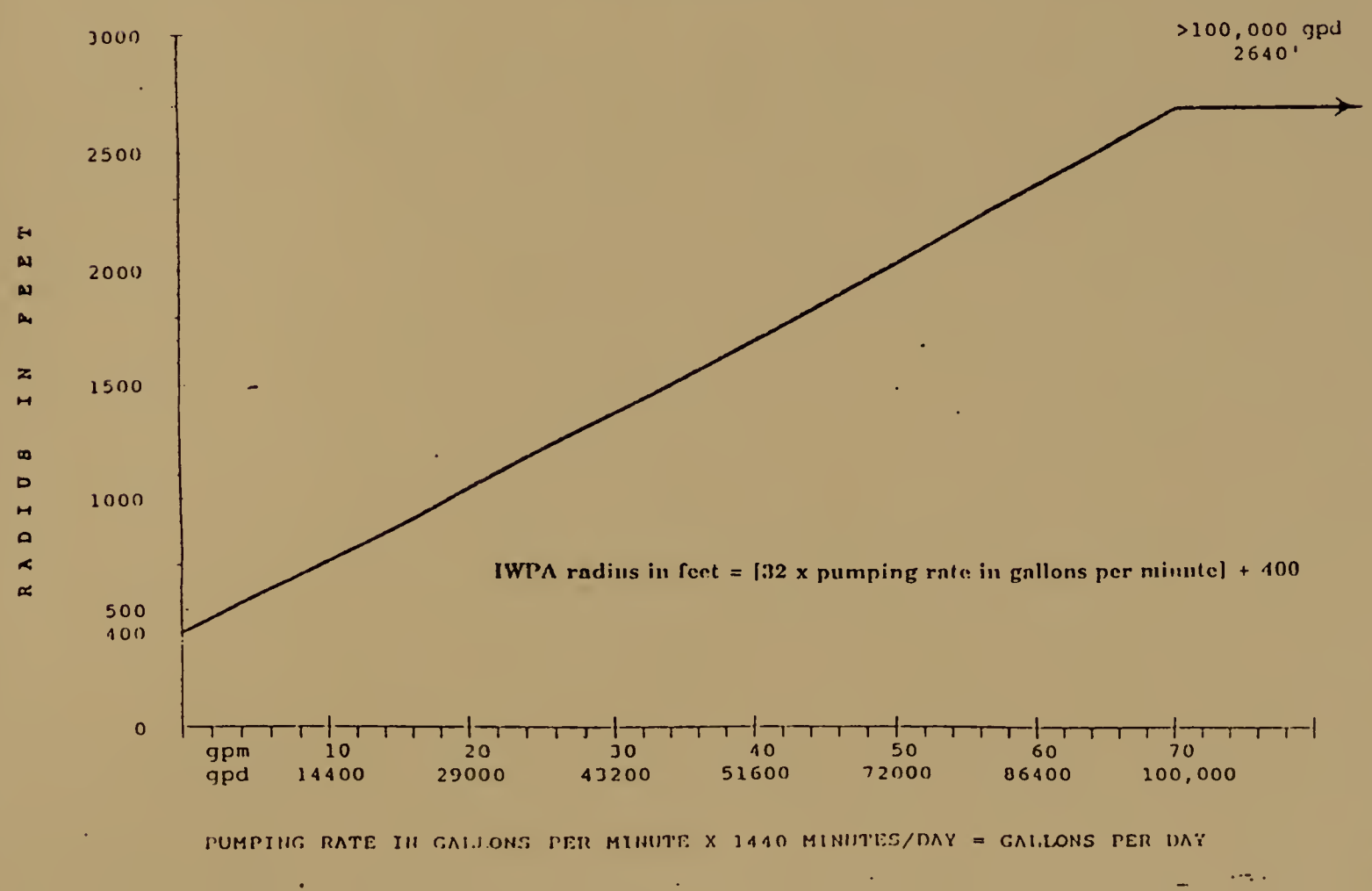
Short term water supply contingency:
Existing interconnection with Groton, MA at West Prescott St. (Rte. 225).
Hydrant within 28 feet of Chelmsford water supply at Brookside Road.

Long term water supply contingency: Westford has two municipal wells in the Source Approval Process which, when approved and put on-line, will increase the system's supply capacity. In addition, the town has investigated the possibility of installing two additional wells near Forge Pond sometime in the near future.

Emergency Contacts:

Westford Police Department	(508) 692-2161
Westford Fire Department	(508) 692-5542
DEP/Division of Water Supply/ Central Region (Worcester)	(508) 792-7650
DEP/Office of Emergency Response/ Central Region (Worcester)	(508) 792-7653
Massachusetts Office of Civil Defense (Framingham)	(508) 820-2000
Massachusetts State Police	(617) 566-4500

APPENDIX 1



APPENDIX 2